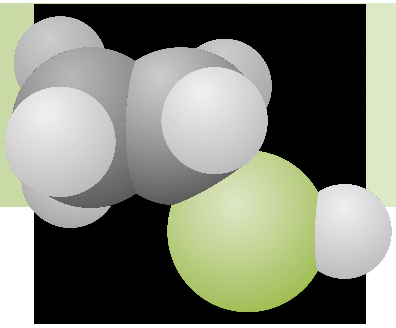
CHEMICALS

Project Fact Sheet



ZEOLITE MEMBRANE

BENEFITS

- Continuous operation at high temperatures
- Resistant to chemical attacks and morphological degradation
- High separation selectivity
- Low operation cost due to low energy consumption
- Low cost per unit membrane area

APPLICATIONS

Low cost, thermally and chemically stable membranes have potential applications in the petroleum refining, petrochemical, chemical, high-purity gas, and environmental industries. These include various light gas separations, close-boiling hydrocarbon separations, dehydration of organic fluids, removal of organics from aqueous streams, and hydrogen recovery.

UNIQUE MATERIAL AND SEPARATION PROPERTIES OF ZEOLITE CERAMIC MEMBRANE PROVIDE STABILITY AND HIGH SELECTIVITY

Membrane technology has proven to have significant energy and cost savings over thermal separation processes. Current thermal and chemical limitations of commercially available membranes and the modules in which they are contained have eliminated many potentially large industrial applications from using this technology. Zeolites, crystalline inorganic structures that have uniform pore size, are viewed as potentially "break-through" materials for membrane manufacture due to their high chemical and thermal stability and homogeneous, tunable pore structure. To provide high permeability and selectivity, zeolites must be cast as a thin membrane layer on an appropriate support. Widespread application of zeolite membranes has been neglected because support structures have not been amenable to the manufacture of membrane modules with costs that are commercially viable for industrial processes.

Initial research developed the methodology to apply zeolite membranes to porous silicon carbide. Separation properties for these membranes were excellent and equivalent to those of other porous substrates. Silicon carbide support monoliths can be extruded in high volumes at relatively low cost. Their geometry is amenable to the application of zeolite membranes and to commercial module development. This project will fabricate highly selective zeolite membranes for nitrogen/oxygen separations on small monolithic supports. These will be tested and scaled up to a large module containing about 3.5 square meters of membrane area.

Zeolite Membrane Module

Photograph of a laboratory-scale zeolite membrane module, based on a low-cost silicon carbide honeycomb support. The module contains 0.13 m^2 membrane area.

Project Description

Goal: Develop a low-cost, high surface-area zeolite membrane module that is suitable for high temperature service and that will be inert to attack by organics and other materials to be separated.

The project will utilize ZSM-5 zeolite to produce a membrane readily applicable to a variety of porous support structures. The zeolite will be applied by conventional hydrothermal processing means onto a unique ceramic support structure. The support structure will be comprised of an underlying, macroporous silicon carbide (SiC) support coated with an alumina microfiltration (MF) or ultrafiltration (UF) membrane will be deposited. The product development will begin with SiC supports in a tubular configuration but will end with membrane modules based on very large, high surface-area monoliths, with individual membrane module areas exceeding 3.5 m^2 each.

Progress and Milestones

Early project research achieved the following milestones:

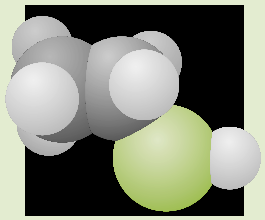
- Demonstrated the porous SiC tubes can be coated with MF/UF membranes suitable for deposition of zeolite microporous membranes
- Demonstated that zeolite membranes have properties equivalent to those deposited onto alumina tubular supports
- Determined the problems associated with coating of these zeolite membranes onto SiC monoliths

Future research will focus on the following project areas:

- Scale up highly selective ZSM-5 membranes to small monolithic supports
- Develop zeolite membranes on tubular SiC support modules that have commercially interesting properties for separation of oxygen and nitrogen
- Scale up oxygen/nitrogen separation membranes to small monolithic supports
- Scale up at least one of the two types of zeolite membranes to larger monolith supports

Commercialization

Once the technology reaches the pilot stage, CeraMem will work with its partners to market the product. Possible commercialization paths include licensing the technology or forming joint venture. Potential applications CeraMem is currently looking into include hydrocarbon separation, dehydration of organic fluid, removal of organics from aqueous streams, and waste water treatment.



Project Partners

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